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Trichiotinus (*Trichius*) *texana* Horn.

Riley, Pottawatomie and Dickinson counties; frequent. June. The adults have been taken on Jersey tea in bloom and on rose blossoms in company with *T. piger* and *Strigoderma arboricola.* They are also attracted to lights.

Valgus squamiger Beauv.

Eastern Kansas; comparatively rare. May. The record of Popenoe (1877, p. 30) concerning *V. canaliculatus* Fabr. probably refers to this species. He says it occurs under logs and in rotten wood. Snow (1881, p. 78) lists this species from Leavenworth county.

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A Preliminary Study of the Life History and Habits of Dione Vanillæ Linn.

VANÇE RANDOLPH.

Some years ago, becoming interested in certain problems connected with the life history of *Dione vanillæ,* I skimmed the scanty literature available, made some observations, and took some fragmentary notes. Having abandoned the study, and being at present occupied with other matters, I am placing this material in the hands of Dr. O. P. Dellinger, to whom I owe my interest in the subject, thinking that perhaps the investigation may sometime be continued by some of his students.

As most of the data was collected near Pittsburg, Kan., all spatial references are to this locality unless some other is specifically indicated.

CLASSIFICATION.

The genus *Dione* Hübner (*Agraulis* Boisduval and LeConte) is confined to the New World. It is classed in the subfamily Nymphalinæ between the genus *Colænis,* from which it is distinguished by the larger palpi, and the genus *Argynnis,* from which it differs in the form and venation of the wings. Of its five species only one, *vanillæ* (Linnæus, 1764), occurs in the United States. Of several so-called popular names, two, the gulf fritillary and the red silverwing, are the most common.

Although the above classification is that generally accepted, having been defended for seventy years by "very competent and critical observers," as Holland remarks, there have not been lacking those who, like Müller, would remove *Dione* and *Colænis* from the Nymphalinæ and unite them with *Heliconius* and *Eueides* in a separate subfamily. Müller called these four genera the *Maracuja* (passion flower) butterflies, and his reasons for changing their classification may be stated briefly under nine headings:

1. These butterflies are all found in the warmer parts of America. All the larvæ feed upon the passion flower; no Nymphalinæ larvæ have been found upon this plant.*
2. Eggs all very similar. Has not seen any similar eggs among the Nymphalinæ.
3. Larvæ all very similar. Has not seen any Nymphalinæ larvæ with the same arrangement of spines.
4. These butterflies all feed on flowers; never on sap, like many of the Nymphalinæ. Never seek water on the ground or upon horse droppings, as many of the Nymphalinæ do.
5. These butterflies emit odors. Nothing like this in the Nymphalinæ.
6. Mouthparts all alike.
7. Scent scales on the hind wings of males (except *Dione vanillæ*); no such scales in the Nymphalinæ.
8. The longitudinal veins and the borders of the wings bear on the under surface one or two rows of black hairs. Not found in the Nymphalinæ.
9. The neuration of the wings in all the *Maracuja* butterflies is extraordinarily similar. True *Heliconius* and *Eueides* have a closed, *Colænis* and *Dione* an open cell in the hind wing, but this is insignificant.
    - (*a*) The median vein in the fore wing gives off near the base a short (interno-median) spur, running toward the inner marginal (submedian) vein, its point curving toward the border (hind or outer margin). This is wanting in those Nymphalinæ genera for which any claim for close relationship to the *Maracuja* butterflies could be made.
    - (*b*) "In the cell of the fore wings there springs from the angle between the median and subcostal veins the stump, more or less long and distinct, of the aborted discoidal." Not found in the Nymphalinæ.
    - (*c*) "Not far from the base of the wing the subcostal vein becomes suddenly thinner at a point where its posterior boundary sharply bends in toward the anterior, the latter preserving its direction unchanged. This is the point at which the subcostal formerly divided into its two chief branches, of which the posterior subsequently disappeared right down to its origin from the anterior." Not found in the Nymphalinæ.
    - (*d*) "As to the hind wings, I will only remark on the præcostal vein curved toward the base of the wing, which distinguishes the *Maracuja* butterfles from *Acræa,* and also probably from all those Nymphalinæ which may claim to approach them."

"One may well inquire," adds Müller, "how it has been possible that masters of lepidopterology have managed to misunderstand a relationship which, as I know from my own family, strikes every child at his first sight of the butterflies on the wing—a relationship which constantly receives fresh confirmation as one learns more and more of their development, life history and structure."

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* *Euptoieta claudia* feeds on *Passiflora.* Its range extends, according to Holland, from southern New England to the Argentine Republic. Whether or not it has been reported from Blumenau, in southern Brazil, where Müller's work was done, I do not know.

Scudder, in 1899, classed *Dione vanillæ* (or *Agraulis vanillæ,* as he called it) with the heliconians, as have other less eminent American entomologists.

IDENTIFICATION OF THE IMAGO.

The brilliant coloring of *Dione vanillæ* is only approached in this locality by that of *Pyrrhanœa andria,* from which it is easily distinguished even at a considerable distance by the silver spots and the remarkably elongated wings. Its manner of flight somewhat resembles that of the genus *Argynnis,* while that of *Pyrrhanœa* is nervous and *Grapta*-like. The colored plates of Holland, Wright and Maynard are good enough to render identification easy and certain. Of the detailed descriptions of wing markings Holland's is perhaps as good as any:

"The upper side is bright fulvous; the veins in the fore wings are black, very heavy near the tips; there are four black spots on the outer border and three discal spots of the same color; there are three irregular black spots toward the end of the cell, pupiled with white; the hind wings have a black border inclosing rounded spots of the ground color; between the base and the outer margin there are three or four black spots; the under side of the fore wings is light orange, the markings of the upper side showing through upon the under side; the apex of the front wing is brown, inclosing light silvery spots; the secondaries are brown, with numerous elongated bright silver spots and patches. Expanse 2.50 = 3.25 inches."

Because of the brilliant coloring of this species, popular literature has come to abound in more or less fanciful descriptions. The following is taken from Winthrop Packard:

" . . . She soared low as if to alight at my feet, and I saw the rich yellow of the upper sides of her aristocratic wings. She hovered and danced up by my eyes, and she seemed robed in shimmering silver, so profusely are the metallic moons scattered over her under wings, and through it all she seemed to blush a vivid red. . . . The lovely, fulvous orange which marks the fritillaries seems in *Dione* to be just a shade richer, but toward the bases of the wings it blushes into a rich wine red, a pellucid crimson, while beneath the after wings are as studded with glittering silver spots as a nautch girl with silver bangles." And so forth.

VARIATION IN SIZE AND COLOR.

As Holland has observed, the male is usually lighter in color and less heavily marked than the female. I have come to believe also that the female is usually larger than the male; that those females which emerge early in the season (August) are larger than those females which appear later (October), and that this seasonal variation is much less conspicuous in the male.

Longstaff remarked that his Jamaican specimens were usually smaller and often more brilliant than those from South America. I once fancied, while watching the living butterflies, that those in southern Florida, particularly the males, were more brilliantly colored than in other states, but a comparison of dried specimens some months later showed no difference. There seems to be an almost universal belief among collectors in California that the eastern *vanillæ* is by no means as beautiful as its west-coast prototype, but it seems to me that the difference, if there be any, is very small.

Aberrations are not uncommon. I have never seen an albino, but have taken two melanic females: one, captured near La Jolla, Cal., was very large, and a sort of muddy, red-olive color; the other, brought in by a small boy at Palm Beach, Fla., was nearly black, the silver spots standing out with a most startling effect.

DISTRIBUTION.

The entire genus being confined to the New World, *Dione vanillæ* has been reported from Mexico, Cuba, Jamaica, Hayti, Porto Rico, Panama, and many points in South America. As to its distribution within the borders of the United States authorities seem to differ somewhat. Holland gives its range as "from southern Virginia southward to Arizona and California." This would practically eliminate Kansas, where I have collected hundreds of specimens, and Illinois, where Mr. W. P. Flint, of the Illinois Natural History Survey, writes me that he "should judge there would probably be about four broods" per annum. If Mr. Flint, by his subsequent statement that *vanillæ* "is well known in all parts of the United States," means that it occurs in all parts of this territory, he is obviously mistaken, and his former statement must perhaps also be discounted.

Maynard confines it to "Arizona and California, but has also been taken at Coalburg, W. Va., Cape May, N. J., and Philadelphia, Pa.," seemingly having quoted from French, who in turn refers to W. H. Edwards, who long ago reported *vanillæ* from Coalburg. An eastern commercial collector of some reputation swears he has taken it in Worcester, Mass., in the middle of July.

In southern California it is abundant the year round, and, in the words of Wright, has become a pest, "as the larvæ feed on the leaves of the passion vine, so the vine becomes a nuisance on account of the caterpillars, and has to be removed." Wright tells us further that *vanillæ* is not native to the west coast, "but was introduced into the country over the Southern Pacific Railroad soon after that was opened up across the interior country to New Orleans, about 1885."

Knowing that *vanillæ* is more common in Oklahoma and Arkansas than it is here, and much less so in northern Kansas, I am inclined to regard southern Kansas as the approximate northern limit of its usual range.

FEEDING HABITS OF THE BUTTERFLY.

As Müller long ago pointed out, *vanillæ* feeds upon the nectar of flowers exclusively. Müller remarked its fondness for a certain poinsettia in his Brazilian garden; in this vicinity preference is given to the cultivated salvia (*S. splendens*) and to a wild purple ironweed (probably *Vernonia noveboracensis*). *Vanillæ* never sucks water from mud and slime, as *Colias, Catopsilia, Terias* and others are so prone to do; never feeds upon the sap of trees, like *Vanessa* and *Grapta,* or upon the ordure of dogs, like *Pyrrhanæa.* Those which I have kept in captivity were never seen to take any food or to alight upon any of the blossoms available, including the two favorites above mentioned. No attention was paid to the dried-apple-and-sugar preparation made famous by Mr. W. H. Edwards.

THE NUMBER OF BROODS.

In the tropics, of course, it has many broods and breeds continuously. Several westeners have told me that this is true also in interior California. Wright says that it flies "at all times and all seasons" near Los Angeles; this is the case also in southern Florida, although it is much less abundant during the winter months. Mr. Flint writes me that there are "probably at least six or eight broods" in California, and adds that he "should judge that there would be about four broods in Kansas, and probably about the same number in Illinois."

As to the number of broods here (Pittsburg, Kan.) I am still in doubt. I have found eggs as early as July 20 and as late as September 28, full-grown caterpillars as late as October 25, chrysalids from August 10 to November 21, and butterflies from August 1 to November 28. Between August 1 and September 10, eggs, larvæ of all sizes, pupæ and adults are all comparatively abundant, the imago, however, never becoming as common as one would suppose from the number of caterpillars taken.

Another thing: For six seasons past male butterflies have each season appeared a week or ten days before a single female could be found. It is of course quite possible that the further accumulation of data will show this to be purely coincidental.

DOES VANILLÆ HIBERNATE?

"Every year," according to J. W. Folsom, "some of the southern butterflies reach the northern states, where they die without finding a food plant, or else maintain a precarious existence." Dr. W. T. M. Forbes writes me that he believes that *vanillæ,* in its northern extremes, "occurs only as a stray, not surviving the winter."

I had previously assumed that the winter is passed in the larval state, as in the case of *Euptoieta claudia,* but have since come to suspect that *vanillæ* does not hibernate at all. I cannot believe that the egg weathers the Kansas winter, because I have never been able to find it later than September 28, and because the butterfly does not appear until about August 1 of the succeeding year. As to the caterpillar, those which I have reared always pupated or died before November 1; besides, a most painstaking search in the vicinity of the food plant has failed to uncover any during the winter. Of some twenty belated chrysalids not one survived the winter of 1917-'18, although several butterflies emerged as late as November 21, and as no living pupæ can be found during the winter, it seems to me most improbable that the chrysalis hibernates in this locality. The fact that the imago does not appear until August 1, the earliest specimens being fresh and in good condition, surely indicates that the winter is not passed in this stage.

On the other hand, I can offer no explanation of the fact that for three consecutive seasons half-grown caterpillars have been discovered some days before I have been able to find either egg or butterfly.

THE SO-CALLED OFFENSIVE ODOR.

Besides several references to "that beautiful but ill-smelling fritillary, *Dione vanillæ,* "Longstaff reports that in Jamaica, in 1907, he examined seventeen males, thirteen of which exhibited an odor varying from very faint to very strong, and invariably offensive. He describes it as "like a stable, like asses, like cow dung." Mrs. Longstaff used the terms "offensive" and "unpleasant," and a Mr. Abell pronounced it "musky." Fritz Müller writes:

"The males, . . . when seized, open wide the anal valvulæ, from the inner side of which there appear two glands yielding a strong and nauseous smell. The females, on the contrary, emit a similar smell from a yellow gland extruded on the dorsum between the last and penultimate segments."

Similar organs and odors occur in *Heliconius* and allied genera; these are fully treated in the voluminous literature dealing with Bates' theories of mimicry. Bates, Darwin, Wallace, Belt, Trimen and others long ago observed that these butterflies and others superficially resembling them were immune from the attacks of tropical spiders, dragonflies, birds and monkeys, and that mounted specimens of the Heliconidæ in particular were rarely molested by vermin. Wallace concluded that this immunity is due to "a strong, pungent, semiaromatic or medicinal odor, which seems to pervade all the juices of their system." Wilson says that this odor reminds him of that of the muskrat, and even of "the still more awful effluvium of the American skunk." Holland remarks that certain butterflies (notably the Euplœinæ) are distasteful to birds and predaceous insects, adding that this is "probably due to the character of the plants upon which the caterpillars feed, for many of them eat plants which are more or less rank, and some of them even poisonous to the higher orders of animals." It is interesting to note, in this connection, that *Passiflora incarnata,* upon which *Dione vanillæ* feeds, is by no means rank or poisonous. In the Southern states the fruits are called maypops and are commonly eaten by children, and, according to Ballou are highly esteemed as food in South America, Australia and New Zealand.

Personally I am unable to detect any characteristic odor about these butterflies, my olfactory sensibility being obtuse. Calling in nine of my friends, however, I find that all of them are able invariably to distinguish, blindfolded, between the sexes, all agreeing that the male emits a very distinct odor. None detected the odor ascribed by Müller to the female, although the "yellow gland extruded on the dorsum" is very conspicuous. None thought the odor especially unpleasant, as did Longstaff and his friends; none would accept Müller's term "nauseous" as properly describing it. "Sweetish, musty, pleasant, spicy, musky, like bees, like daisies"—these are some of their descriptions.

I have myself tasted freshly killed specimens of both sexes, crushing the bodies between the teeth and holding them in the mouth for some time. The taste is unpleasant, but not at all violently so, reminding one of the taste of the seeds of the common sticktight (*Bidens frondosa*). I was unable to detect any difference between the sexes in this regard. Have been unable as yet to check these results against the experience of others, my available observers having refused their services.

Very little seems to be known about the actual functioning of this odor as a protection against birds and other enemies. Personally, never having seen a butterfly of any species pursued or captured by a wild bird, I incline to the view that the number destroyed by birds, in temperate America at least, is inconsiderable. The lack of butterfly remains in the thousands of bird stomachs examined by McAttee, Forbes, Kalmbach, Beal, Weed, Dearborn and others is significant. David Sharp says, in criticising Bates' theories, "It has not been found, as a matter of fact, that even unprotected butterflies are much destroyed in the perfect state by birds." Men like Marshall, Jones and Poulton, however, regard birds as the chief enemies of butterflies, while Frank Finn, whose work was done in India, writes: "There is a general appetite for butterflies among insectivorous birds, even though they are rarely seen, when wild, to attack them."

THE ALLEGED ATTRACTIVE ODOR.

Besides the offensive odor emitted by the abdominal scent organs, Müller held that the males of this and other allied genera are supplied with another and quite different perfume, which is attractive to the female of the species. He believed this odor due to the functioning of scent scales (*Duftschuppen*) on the fore wings.

The peculiar character and arrangement of the scales along veins one to six, inclusive, in the fore wings of the male is apparent to anyone without the aid of a lens, and affords a convenient means of distinguishing between the sexes at a glance. Scales of this nature have been known since Bernard-Deschamps, who for some reason called them plumules; some later lepidopterist—Scudder, I believe—has given them the better name, androconia. Thomas, writing in 1893, described these scales as hollow tubes connected with glands, and thought that matter secreted by the glands passes out through the scales and becomes diffused.

Scudder, it appears, made no distinction between the two very different odors described by Müller, for he remarks that it has never been proven that any odor produced by the male attracts females, and hints that the function of the androconia is perhaps mere ornament. Referring, in 1880, to butterflies in general, he writes: "The location of the scent organs has never been properly attempted. It is idle to suppose that in so small a creature one may fix the region of the body where they belong by such rude tests as merely smelling of various parts, as Fritz Müller and his family have done," adding that the organs will probably be found on the body near the end of the abdomen.

That the odor perceived by my observers has no connection with the scent scales I have proven by cutting off the wings, when the quality and intensity of the odor were in no wise altered or diminished. I have also tried the effect of presenting these wings before blinded females, with negative results. This latter means very little, however, as I found it inexplicably difficult to get these butterflies to copulate, or indeed to exhibit any indications of sexual excitement in captivity.

As Sharp has pointed out, "in nearly all Lepidoptera it is the male that seeks the female." This being the case, it seems improbable that the so-called scent scales, occurring only in the male, are of any great importance in mating.

OVIPOSITION.*

"One of the females, alighting upon the upper side of a leaf within ten inches of my face, suddenly elevated the forward part of the body, brought the wings together vertically, curved the abdomen slightly forward, and drew its tip slowly across the surface of the leaf for a distance of approximately 12 mm. Remaining quiet for an instant, it lifted the abdomen, showing the egg firmly attached to the leaf. The eggs are laid singly, usually in the upper middle of one of the three lobes of the leaf. I have never seen more than one upon the same leaf." (August 5, 1917.)

THE EGG.

"The egg measures about 1.2 mm. in height and .7 mm. in diameter at the widest part, barrel-shaped, with fourteen vertical ribs. A brilliant yellow at first, it assumes after about thirty-six hours a reddish-brown color. A few hours later an irregular, whitish broken ring, not quite circling the egg, appears about one-third of the distance from the top. When within an hour or so of hatching the shell becomes very thin and transparent and reflects the light with a sort of frosted-glass effect. The large black head of the larva inside gives the upper one-third of the egg a black, metallic appearance, while the yellowish body may be seen curled up in the lower part. The incubation period seems to vary greatly with the temperature, from forty-seven hours (August 7, 1917) to seven days." (September 22, 1918.)

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* This and succeeding dated and quoted paragraphs are copied without revision from my daily notes.

THE EMERGENCE OF THE CATERPILLAR.

"At 2:15 p. m. the larva was clearly visible through the shell. Slight bodily movements were noted, then the very large, shining black head was thrust out at a point on one side of the egg, just below the top. The entire structure rocked and swayed slowly back and forth, inclining toward the side from which the head projected.

"At 2:19 the larva emerged very slowly, head first. The head and the final segment appeared very large. The entire length was about 1.5 mm. The body yellowish red; prolegs and caudal segment lemon yellow; the head, legs and spines black. The latter bear no visible branches, and appear as stiff, black hairs, each growing out of a slight black protuberance.

"The beautiful eggshell remains erect, the form being unchanged. There is a ragged hole in it, but it is scarcely noticeable, and appears hardly large enough for the egress of the caterpillar." (September 22, 1919.)

THE CATERPILLAR.

"The newly emerged larva does not venture far from the eggshell and does not move about much for the first five or six hours. It sometimes devours the shell, but this is not usually the case. At the age of six hours it appears darker, and the black spots from which the hairlike spines protrude have become more conspicuous. Has not eaten any of the leaf, and has increased in size very little if at all." (September 20, 1917.)

"At the age of twenty-seven hours the larva attains a length of 2.3 mm. and has eaten several small holes in the center of a large leaf, gnawing through the leaf to the transparent epidermis on the opposite side, which is left intact. Usually works from the upper side, but by no means invariably." (August 10, 1917.)

"These smaller larvæ seem to be always attached to the leaf with silk, although the threads are very few and fine. More mature larvæ feed differently; they grip the petiole with the prolegs, and eat from the edge inward and forward, swinging the head toward the midrib, with practically no lateral motion." (September 1, 1917.)

"The caterpillar is cylindrical and bears six rows of black, branching spines, twelve in each row. As regards color, there are, besides the reddish, newly hatched type described above, two well-defined types: the orange drab and the drab orange. In the first the body appears orange with three narrow drab stripes, and a very narrow lateral line just above the prolegs. In the second the drab markings become very much more prominent, so that the body now appears drab with four narrow orange stripes. The narrow drab dorsal line of the younger caterpillar becomes very conspicuous in the mature larva, separating the dorsal surface into two distinct orange areas. As the orange-drab type seems to embrace all of the smaller larvæ, and as all those about to pupate belong to the drab-orange type, I have assumed that the color change is a matter of maturity. Whether the change comes gradually or is the immediate result of moulting I do not know." (September 10, 1918.)

"The mature caterpillar," says French, "is 1.5 inches long, of a red-orange color, with a broad dorsal line of greenish black and a broad slate-black band outside this reaching to the first lateral, except a narrow stripe of the ground color. Base slate black, orange through the region of the spiracles."

I can make nothing of this description. The mature caterpillars which I have reared were invariably of the drab-orange type described above. I have collected these larvæ in Kansas, Missouri, Oklahoma, Arkansas, Tennessee, Louisiana, Florida and California, and have seen specimens from several other states and from Mexico. Of these the larger larvæ (which I take to be the more mature specimens) were always of the type which I have called the drab-orange.

MISTAKEN IDENTITY.

"The only caterpillar which is likely to be confused with *Dione vanillæ* is that of *Euptoieta claudia.* No other larva of similar appearance feeds upon *Passiflora* in this region. The general outline is much more slender than in *vanillæ,* the two head spines are knobbed at the ends and are straight instead of incurved, and the spines are steel blue instead of dead black. The color scheme is approximately that of the orange-drab type, but the stripes are whitish yellow rather than drab, and broken instead of solid. The head is less prominent than in *vanillæ,* and lacks the black visor markings so conspicuous in the latter. These larvæ seem to appear at about the same time as *vanillæ,* but are less abundant, although the butterflies are common enough from the middle of July to October. *Claudia* undoubtedly passes the winter in the larval state, while *vanillæ* probably does not hibernate at all in this locality. The *claudia* caterpillar feeds sometimes upon violets, and perhaps other plants, while *vanillæ* is found only upon the passion vine. The chrysalids are very different, that of *claudia* being nearly white." (August 10, 1918.)

MOLTING.

"11:30 a. m.—Larva about 21 mm., inactive and very dark, extended on lower side of leaf, front of body high, head bent, holding with third, fourth and anal prolegs. A few silk threads lie flat on leaf near caudal end of body. After some little rippling of muscle (no violent motion) the skin of the body separates from that of the head. The former is very tight; slowly, segment by segment, it is skinned backward until finally it is left, a crumpled, prickly black ball about 4 mm. in diameter, fastened to the leaf by the aforementioned silk. Meanwhile the head covering, which is all of a piece and bears two large spines, slips forward until it appears to be held in the mandibles as a hat might be held between the teeth. After a moment it falls to the ground. The caterpillar now appears somewhat short and a trifle thickened. The head, legs and prolegs are yellow, the body orange. The spines are only half size, blunt, yellow and semitransparent. The branches appear as black hairs lying flat along the sides of the spines.

"11:33 a. m.—The spines have now attained practically their normal size, springing out with astonishing rapidity. They are still blunt, yellow and semitransparent, but the black branches have reached normal size and assumed their proper position. The two head spines, which were curled backward, have taken on the usual angle. The head, body and prolegs now appear orange rather than yellow, the head being lightest. The drab dorsal stripe has appeared, but is very narrow. The row of depressions, one in the dorsal center of each segment, is much more conspicuous than usual.

"11:50 a. m.—Appears quite normal again, except that the spines are not quite as black, showing grayish toward the tips. The black frontal markings appear. Caterpillar rests motionless.

"12:10 p. m.—Turns about and begins to devour the cast-off skin. With the lens I watched it begin at the tip of one of the big spines and consume it clear to the root, apparently in about three mouthfuls. The head covering is never eaten.

"12:30 p. m.—Skin practically consumed. Larva rests motionless, a few of the surplus spines resting beneath the head and thorax." (September 10, 1918.)

PUPATION.

"10:00 a. m.—Caterpillar, 37 mm. long, leaves food plant and begins to wander restlessly about.

"1:00 p. m.—Extended motionless, clinging to under side of window frame.

"2:30 p. m.—Same position.

"3:30 p.m.—Begins to lay a sparse, ragged network of very fine threads flat to the surface, covering a space of perhaps an inch square. These threads thin toward the periphery of the net, where they are hardly visible without a lens.

"4:00 p.m.—Spins a little white silk button in the center of the network. The head moves slowly out horizontally in all directions from the button about one-half inch, swinging always back to center. The body is fully extended, the abdomen being away from the button.

"4:30 p.m.—Interrupted the button-making to raise high the caudal third of the body, spreading the anal appendages apart several times. When a pellet of excrement appeared, the caterpillar turned about and pulled it out of the foramen ani with the mandibles, holding it thus a moment before allowing it to fall to the floor.

"4:45 p.m.—Resting, body extended, clasping the button with the third prolegs.

"6:00 p.m.—Fastened to the button. The body is extended horizontally, clinging to the under surface of the window frame with the prolegs; head drawn back, legs not touching the surface.

"8:00 p.m.—Hanging from the button. The body is thickened a trifle and shortened to 31 mm. Color much lighter; hangs motionless except for very slight movements of the legs and prolegs." (September 4, 1918.)

"9:00 a.m.—No change.

"10:00 a.m.—The brilliant colors have practically disappeared, leaving the body a pearl-gray color, against which the black spines show up with startling distinctness. Movements slight and infrequent. The dorsal thorax is now the lightest part of the body.

"11:00 a.m.—Begins to wriggle a little.

"11:10 a.m.—I note that the spines appear closer together at the caudal and of the body; then see that the skin has split down the back and that the light-colored head of the chrysalis is protruding. By a series of vigorous wrigglings the skin is slowly forced up to where the tip of the abdomen is attached to the button. Then comes the violent struggle which finally loosens the skin, which hangs for a moment against the ventral abdomen, then falls to the floor. Then entire molt is complete in less than five minutes." (September 5, 1918.)

THE CHRYSALIS.

When the chrysalis first appears it is nearly cylindrical; no dorsal depression, no ventral bulge. The head is bent forward, and the whole thing has a compact, sluglike appearance. An hour or so later the head is no longer bent, and bears two double projections, set wide apart; the wing cases are bulging and prominent; on the dorsal side, opposite the middle of the wing covers, is a U-shaped depression; there are projections on the third, fifth, sixth and seventh abdominal segments, those on the third being the largest. At first the head, thorax and wing covers are translucent and nearly white; the abdomen is a little darker and bears a ventral bluish stripe on the fourth, fifth and sixth segments. The four pairs of dorsal protuberances are amber-colored.

An hour later the head and thorax darken somewhat, and opaque whitish veins appear in the wing covers. Distinct black lines mark the outer borders of the fore wings, and a black V-shaped mark shows the position of the larger of the three discal spots.

Another hour and the translucent appearance is gone, the abdomen and the dorsal thorax become much darker, the wing covers grayish tan, while the bluish ventral stripe turns gray or white.

From this time forward the chrysalis does not change appreciably in form or color (although the latter varies greatly) until about twenty-four hours before emergence, when the entire body becomes very dark.

French finds a very wide variation in color: "Some specimens buff with greenish markings, or on the abdomen greenish brown; some black, the wing cases and anterior parts mottled with light and dark black; some with the anterior parts pink tinted, mottled with greenish black."

The average length of the chrysalis is 28 mm. and the white ventral stripe is usually the most conspicuous marking. After the butterfly has emerged the color variations of the chrysalis still persist in the empty shells, some being much darker than others.

Not infrequently the cast skin of the larva is found attached to the anal portion of the chrysalis. This skin is black excepting the head, which is gray, and the black branching spines loom large because of the contraction of the empty skin.

Sometimes the chrysalids turn bright yellow; these are usually infested by parasites. I have opened many of these pupæ, but have never found the parasitic larva itself; the pupæ and adults I have often taken, the latter being a small (2.3 mm.), green hymenopterous insect which I have not as yet had the opportunity to classify. Some ten or a dozen of these insects emerge from a small round hole, usually in the wing cover, in early August. (September 3, 1918.)

PUPAL MOVEMENTS.

"The chrysalis seems unable to bend the body toward the back or toward the wing covers; sidewise, however, it can turn until the body is extended nearly parallel to the horizontal surface from which it is suspended. Six chrysalids which hung in a north window in September, 1919, and which I observed for fourteen days, were noted to be invariably and unanimously pointed inward (toward the warm room, that is) every morning. During the warmer part of the day there was no uniformity in position. Six specimens—fourteen days; it appears to be more, perhaps, than mere coincidence. The pupal sensibility to light and temperature stimulii should be worth investigation." (October 1, 1919.)

THE APPEARANCE OF THE BUTTERFLY.

"Two or three weeks after pupation (the period varies with the temperature, from eight days in August to twenty-seven days in November) the chrysalis turns nearly black, and a diagonal fissure appears on either side, extending from the back of the head down along the antenna cases, nearly to the middle ventrum.

"About twelve hours later, after some little wriggling, the ventral triangle formed by the covering of the head, antennæ and mouth parts falls open trap-door fashion, the antennæ covers serving as hinges and the flexing point being about one-third of the distance up the wing covers from the abdomen. There is also a dorsal cleavage following the medial dorsum to the first abdominal segment, then the outline of the wing covers to a point half way to the end of the antenna covers. The crumpled-wing imago wriggles out and mounts the empty shell, to which it clings by the four hinder limbs, turning the entire body back and forth as if mounted on a pivot. In each of these turns the body describes an arc of nearly 90 degrees, the body being held stiff. The angle of the body is about 45 degrees from the vertical, the head being uppermost. The proboscis is usually partially unrolled. In five or six hours the soft, wrinkled wings spread and harden, and the insect is able to fly. A thin, transparent liquid, and sometimes a thick, reddish substance, are voided by the newly emerged butterfly. Both of these liquids seem to be odorless." (October 5, 1918.)

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A Kitchen Disinfectant.

F. A. Patty and L. E. Sayre.

During the period of the invasion of influenza every possible source of and every possible means for spreading contagion were sought for and checked by the Board of Health. One of the suspected possible sources of communicating the contagion was that of soda-water tumblers. Many dispensers of soda water employed paper tumblers; others installed running water at scalding temperature; others used steam; and still others employed an adequate sterilizing apparatus at considerable expense. But the majority of stores, whose business, in small towns, was comparatively small, and for other reasons were unable to adopt either method. Accordingly, the Board of Health requested the department of pharmacy to devise a sterilizing bath that would accomplish the purpose at a minimum of expense, so that it would be within the reach of every retailer. It was suggested by one of us that a sodium hypochlorite solution bath would be quite sufficient for the purpose of cleansing and disinfection, but this was merely a statement. In order to verify such